Space Weather Technical Forecast

Issued on Saturday, 15 October 2022 at 01:10 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: M-flare risk declining.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Moderate, with a long period M1.3 flare observed from AR3112, peaking at 14/0944 UTC. Both AR3112 and AR3116 have now rotated off the Earth-facing disc, over the northwest limb, however significant magnetic looping is still evident from this complex. This leaves two small and simple sunspots on the disc, however they are both decaying. There are also a number of filaments on the Earth-facing disc. One of these erupted in the southwest at 14/2200 UTC however it remains too soon to judge if any subsequent CME will be Earth-directed. No other Earth-directed CMEs have been observed.

Solar Wind / Geomagnetic Activity: The solar wind, as observed by ACE and DSCOVR at L1, is indicative of the arrival of the fast wind from CH32, likely combined with some weak CME influence. Background speeds at 300 km/s erratically increased to peak at slightly elevated levels of 450-500 km/s by 14/2030 UTC. Density initially increased to above average levels by 14/0300 UTC with a peak of 27 ppcc, before easing back to mostly average. The total IMF strength, Bt, was Weak at first but increased to Moderate around 14/0300 UTC, jumping to Strong at 14/0815 UTC with peak values 15-18 nT. This then declined back to be mainly Moderate from 14/1400 UTC. The north-south component, Bz, was southward directed at first reaching -15nT by 14/0815 UTC, before rotating to be mainly northward, peaking 15nT, but with further brief periods of negative pointed field. The phi angle was mostly negative (towards the Sun). Geomagnetic activity was Quiet to Active (Kp 2-4).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) as measured at GOES16, has remained at background levels. High energy electron flux at GOES16 (greater than 2MeV) quickly fell from Moderate at 14/0000 UTC, to be mostly Background. The associated fluence was above the Active (1e8 integrated pfu) threshold at first with peak value 1.75e8, but declined to be below this by 14/1500 UTC. The 15/0000 UTC observation was 3.83e6 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is forecast to be mostly Low, with a chance of rising to Moderate on day 1 (15th), mainly from any flares from AR3112. While this is no longer on the Earth-facing disc, the associated magnetic looping remains visible above the northwest limb, potentially allowing any notable flares to be observed from Earth.

Solar Wind / Geomagnetic Activity: There are no Earth-directed CMEs, however the peripheral effects of a CME passing south of Earth late day 2 or 3 (16th or 17th) may be observed. Otherwise ongoing fast wind influence from CH32/- is expected to ease towards background. Geomagnetic activity is forecast to be Quiet to Unsettled, but with a chance of Active intervals early day 1 (15th) or late day 2 (16th) into early day 3 (17th).

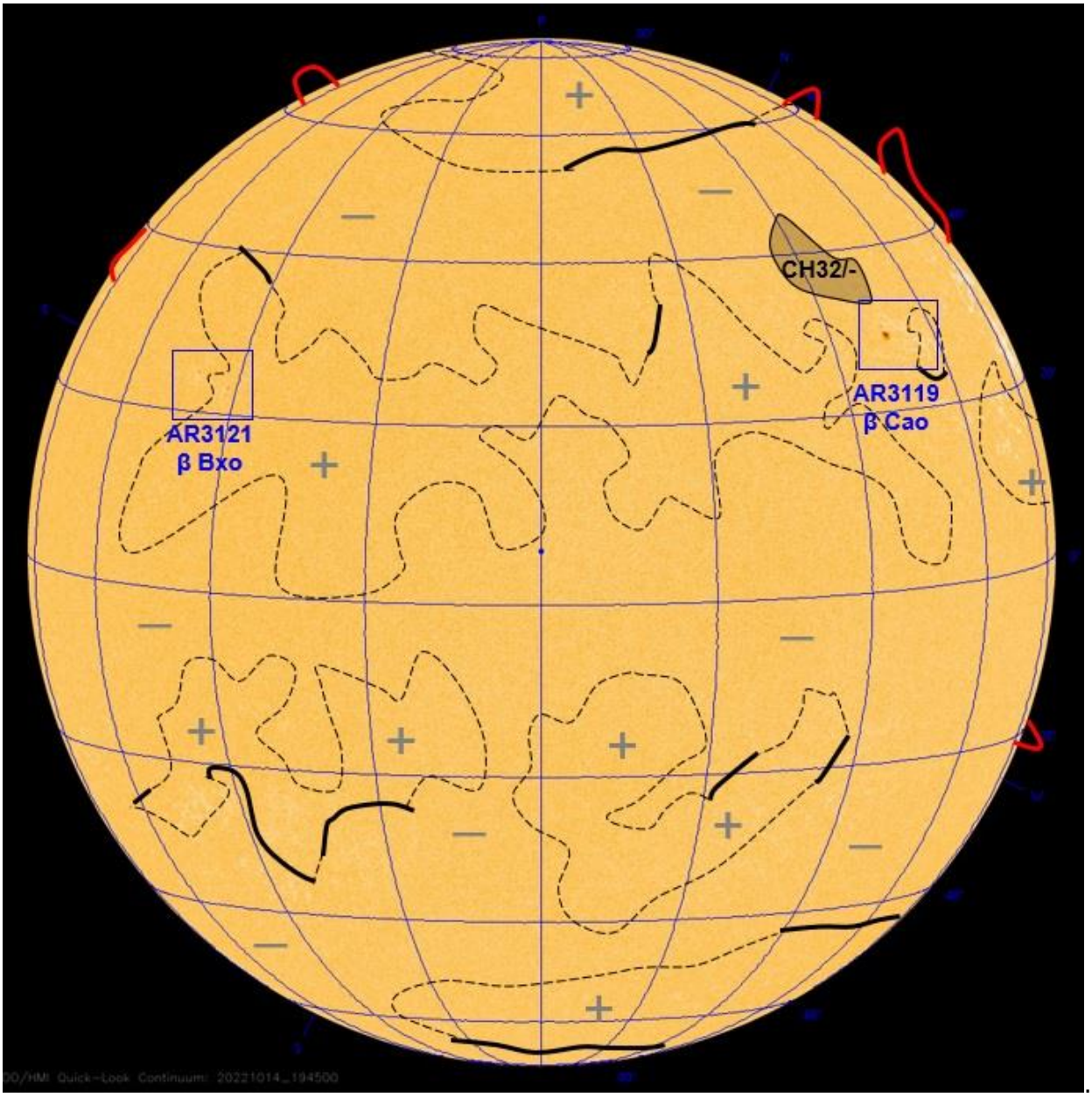
Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10MeV) is expected to be at background levels. High energy electron flux (greater than 2MeV) has dropped out to near background levels, although flux levels are likely to recover during the period,

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

perhaps reaching High at diurnal peak. The associated 24hr fluence is expected to persist below the Active (1e8 integrated pfu) threshold, but likely rising later in the period. There is a chance of Active fluence by the end of day 3 (17th).

Figure 1. Solar Analysis Valid 14/2000 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

Geomagnetic Storms:

There are no Earth-directed CMEs however a CME was observed from a filament eruption from the southern centre disc early on the 13th. The bulk of the material is expected to pass below Earth's orbit, however peripheral glancing effects are possible, most likely late day 2 (16th) on early day 3 (17th).

Current fast wind enhancement from CH32/-, perhaps amplified by the peripheral influence of a passing CME on the 14th, is expected to persist day 1 (15th) leading to slightly elevated to elevated winds peaking around or just below 500 km/s. These winds then gradually easing back towards background through the rest of the period. No other coronal hole features are expected through the period.

Geomagnetic activity is forecast to be Quiet to Unsettled, but with a chance of Active intervals early day 1 (15th) from ongoing fast wind effects, or with any influence from the glancing CME late day 2 (16th) or early day 3 (17th).

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	10	5	5	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

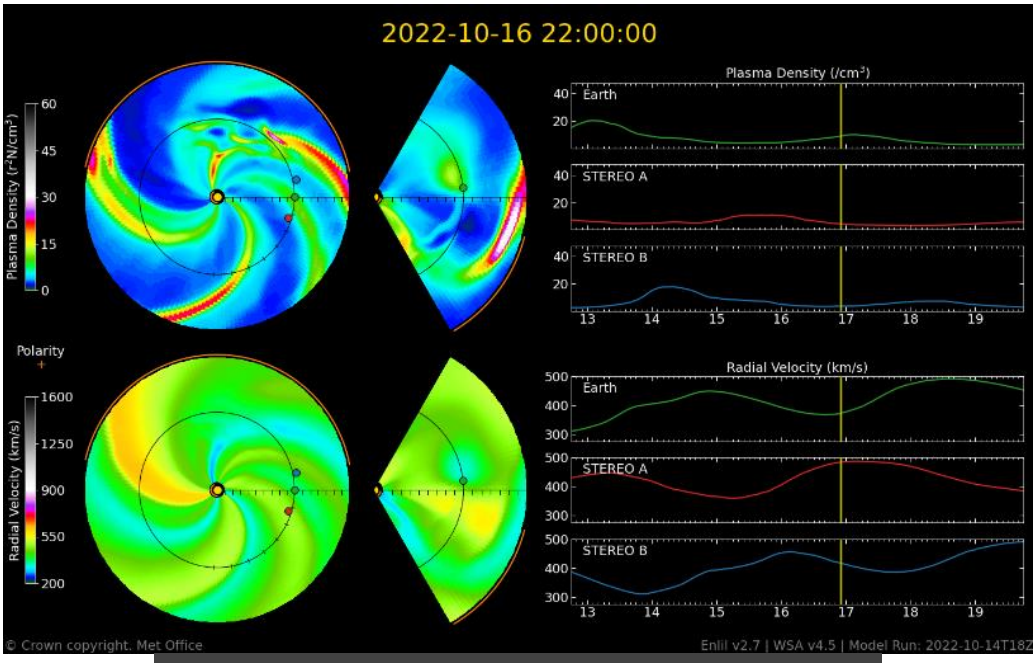
Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
13/1610	Partial	Filament Eruption	S-centre	408 km/s	Missing	Chance of peripheral influence late 16th or 17th

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

Figure 2: Enlil with ensemble, showing CME passing south of Earth.



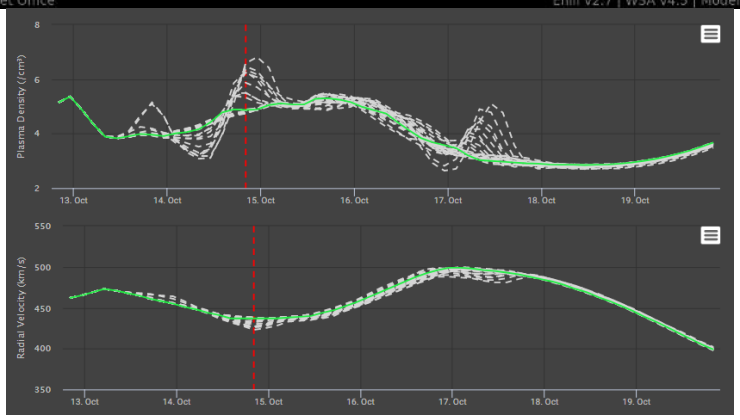
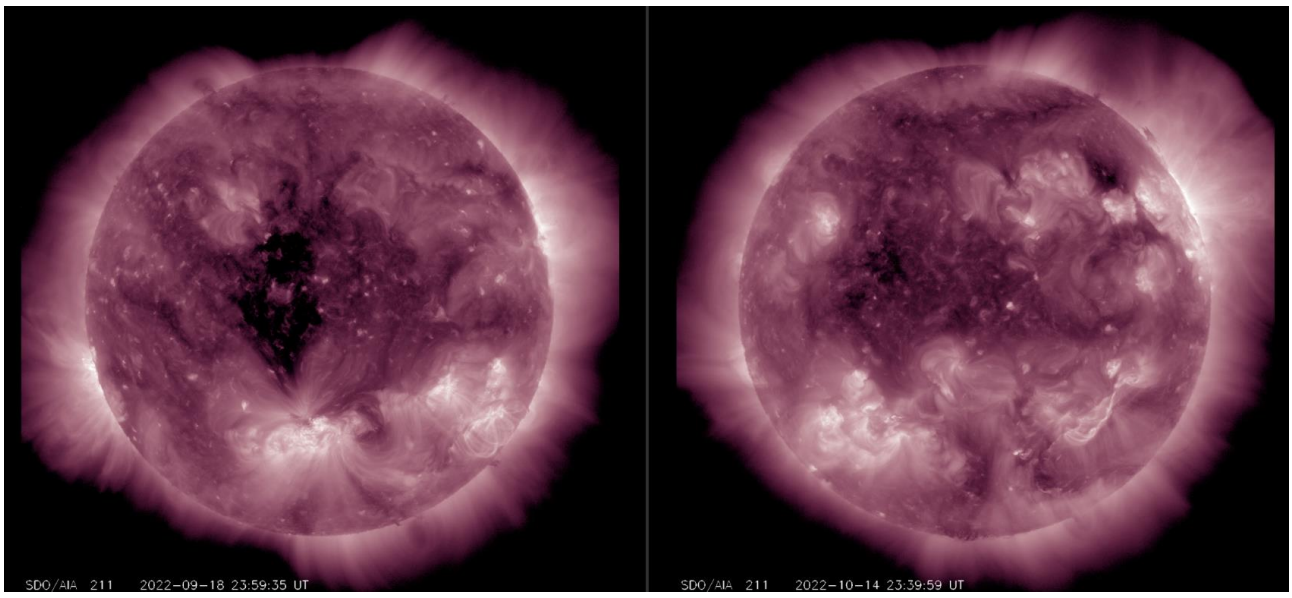


Figure 3: SDO aia 211 of previous (left) and current (right) rotation and no central disc CH.



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

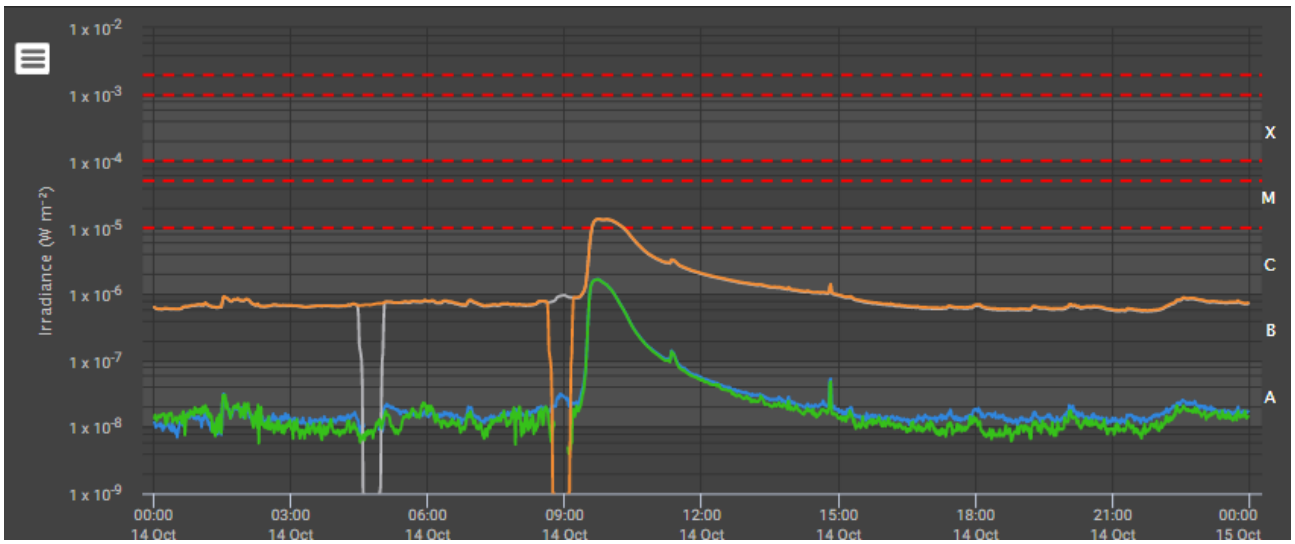
© Crown Copyright 2022. All Rights Reserved.

Radio Blackouts - X-Ray Flares:

Activity has been Moderate with a long period M1.3 flare peaking at 14/0944 UTC from AR3112 (Eso/Beta). This region has now rotated off the Earth-facing disc, over the northwest limb, along with AR3116 (Hax/Alpha). With significant magnetic looping still present and visible on SDO imagery from this complex, a risk off further M-flares is maintained. AR3119 (Cao/Beta) and AR3121 (Bxo/Beta) are both relatively small and simple and have shown signs of decay.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	20	5	5	5
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 4: GOES 16/17 X-Ray Flux



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10MeV) as observed by GOES-16 is currently at background levels and expected to remain at this level. AR3112 has now rotated off the disc, and whilst far-sided flares can produce a proton response at Earth, the lack of response from recent M-flares reduces this potential.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	2	1	1	1
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2MeV) as observed by GOES-16 has been at background, having dropped out due to impact of the recent fast wind arrival from CH32/-. Electron flux is expected to increase again as solar winds ease, rising to Moderate, and perhaps reaching High at diurnal peak, although with low confidence.

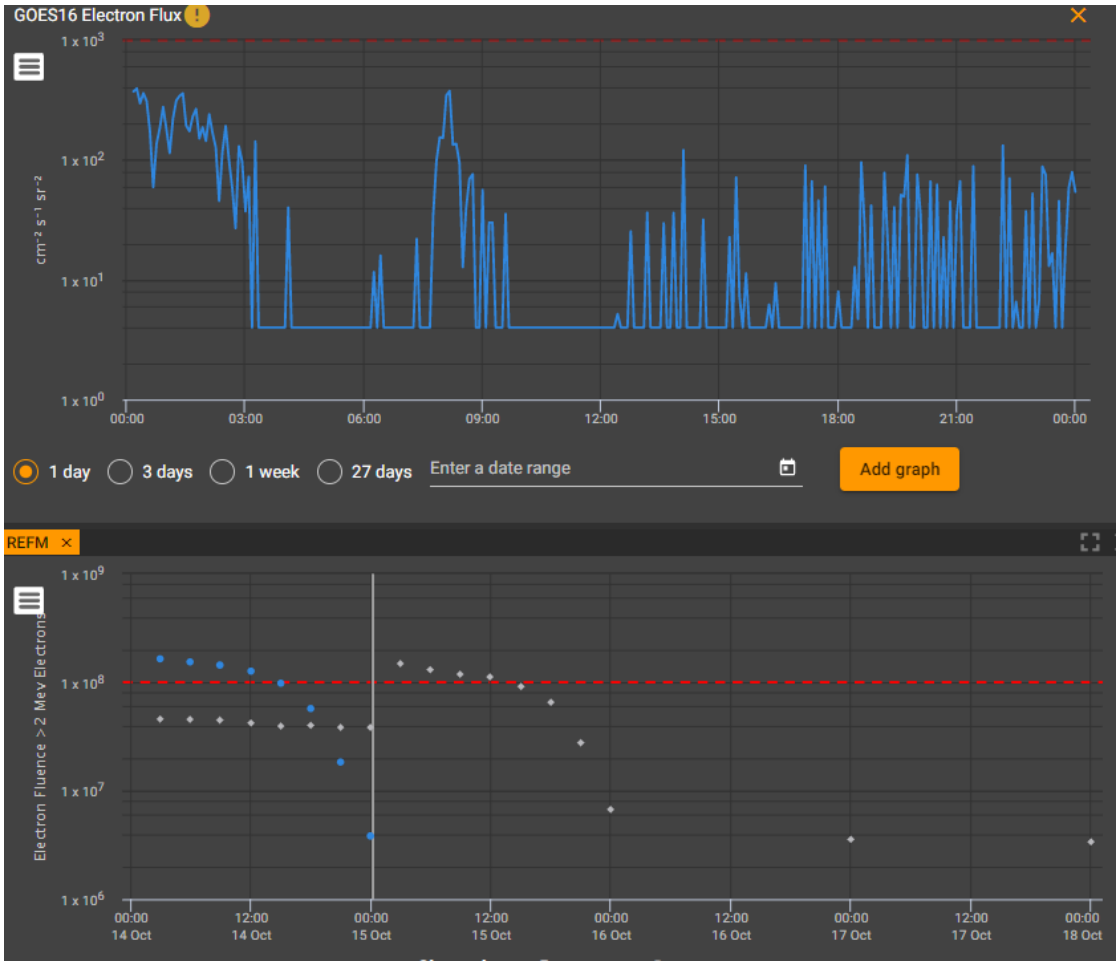
The associated 24 hour electron fluence is likely to remain below the Active level, but with a rising trend as flux levels increase. There is a chance that this may approach, or perhaps exceed Active by day 3 or day 4. REFM has yet to correct for the current fast winds, so is unreliable, despite also suggesting that fluence levels will remain below the Active level.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	Yes	5	20	30	30
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

Figure 5: GOES-16 >2MeV Electron Flux and Fluence with REFM



© Crown Copyright 2022. All Rights Reserved.